# SYNTHESIS, CHARACTERIZATION AND BIOLOGICAL STUDY OF HOMO AND HETEROCYCLIC SCHIFF BASES WITH DIVALENT TRANSITION METAL ION COMPLEXES

**A Synopsis**

*Submitted to*

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**DOCTOR OF PHILOSOPHY**

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## INTRODUCTION

Many Schiff bases and their complexes have been widely studied because of their industrial applications. Schiff base compounds containing an imine group (–RC=N–), are usually formed by the condensation of a primary amine with an active carbonyl. The interest in Schiff base compounds as analytical reagents is increasing, since they enable simple and inexpensive determinations of different organic and inorganic substances.

A large number of heterocyclic Schiff base ligand and their transition metal complexes have been investigated not only for their biological application, thermal analysis, spectral analysis but also for their interesting coordination chemistry such as Cu(II), Co(II), Ni(II), Zn(II) and Ru(II)complexes with the Schiff base ligand derived from 5-amino-4H-1,2,4-triazole-3-thiol and 3-hydroxy-4-methoxybenzaldehyde, benzothiazoleimino-benzoic acid ligands and their Co(II), Ni(II), Cu(II), Zn(II) and Cd(II) complexes. Again synthesis of bidentatetriazole ligand and its monomeric metal complexes in the company relating to Cd(II), Co(II), Fe(III), Cu(II), and Ni(II) ions is demonstrated and their antibacterial study relating to Ni(II), Cu(II), Fe(III), Cd(II), and Co(II) complexes of 4-amino-5-stearyl-1,2,4-triazole-3-thiol.[1,2,3,4] Mostly Schiff base with multiple and different coordination sites their metal complexes and different oxidation property. In general aromatic aldehyde reacts faster than ketones in condensation reaction leading to the formation of ligand. Schiff base ligand of aliphatic aldehyde and ketone are relatively unstable compared to that of aromatic aldehyde because the presence of effective conjugation present in ring system. Schiff base ligands are easily synthesized from condensation of aliphatic or aromatic aldehyde with primary aliphatic or aromatic amine in ethanolic solvent the reaction is accelerated by adding the catalytic amount of acid.[5] The common structural feature of these compounds is the azomethine group with a general formula (R–CH = N–R,) Where R is any alkyl group which may be variously substituted. These compounds are also known as anils, imines, azomethine.[6] Schiff base are well known for their wide application and are useful intermediates in organic synthesis.[7] These compound has intrinsic biological activities, including anticancer,[8] antitumor,[9]antitubercular,[10] antibacterial,[11] antifungal and antifertility,[12] herbicidal,[13] antioxidant,[14]antiproliferative,[15] activities. Moreover Schiff bases also exhibit fluorescence,[16] photoluminescence,[17] and potentiometric titration,[18] aggregation,[19] and anthelmintic activities.[20]

Heterocyclic compounds play an important role in industry as well as in our daily life. Various natural products contain heterocyclic compounds such as alkaloids and glycosides and they have been used in medicines since ancient time. Most of the alkaloids are nitrogenous bases, occurring in plants. Further, many antibiotics including penicillin and streptomycin also contain heterocyclic ring system. Important drugs such as suphathiazol, pyrethrin, rotenine, cocaine,

barbiturates also possess heterocyclic system. These compounds are also known to be used as starting material for the synthesis of new drugs.

## REVIEW OF LITERATURE

Schiff base complexes of transition metal have paid great attention in the recent years due to their easy accessibility for synthesis, stability and various biological activities such as antimicrobial, antifungal, antidiabetic, anti-inflammatory, antitumor and antiviral etc. Besides their biological role, several other applications such as catalytic, corrosion inhibition effect, industrial and electronic applications further enhance their importance. This may be due to the presence of azomethine( >C = N - ) linkage, which coordinate to the transition metals very easily showing notable antimicrobial and antifungal activities as compared to parent ligands.

The importance of Schiff base complexes for bioinorganic chemistry, biomedical applications, supra molecular chemistry, catalysis and material science, separation and encapsulation processes, and formation of compounds with unusual properties and structures has been well recognized and reviewed. Schiff bases resulted from aromatic aldehydes orthosubstituted with a hydroxyl group have initially arouse the researcher's interest because of their ability to act as bidentate ligands for transitional metal ions. A large number of different Schiff base ligands have been used as caution carriers in potentiometric sensors as they have shown excellent selectivity, sensitivity, and stability for specific metal ions such as Ag(I), Al(III), Co(II), Cu(II), Gd(III), Hg(II), Ni(II), Pb(II), Y(III), and Zn(II).[21-27] Schiff bases have been reported for various biological properties, such as, antibacterial, antifungal activities.[28-31] Metal complexes of them have been widely studied for anticancer and herbicidal applications.[32-33] They serve as models for biologically important species. O-phenylenediamine Schiff bases show clinical properties.[34]Isatin Schiff bases were reported to possess antiviral, anti-HIV, antiprotozoal and anthelmintic activities.[35] They also exhibit significant anticonvulsant activity, apart from other pharmacological properties.[36] Certain cobalt Schiff base complexes are reported as potent antiviral agents.[37] Schiff bases derived from 4-dimethylamine benzaldehyde shows antibacterial activity. In medicines used as antibodies and anti-inflammatory agents.[38-42]

In the present work we herein synthesize and characterize homo and hetero cyclic Schiff bases with the divalent transition metal complexes and biological study as well.

## OBJECTIVES

1. **Synthesis of Homo and Heterocyclic Schiff bases Divalent Transition Metal Complexes**

The primary objective is to synthesize divalent transition metal complexes using homo and heterocyclic Schiff bases. This would involve the preparation of Schiff bases and their subsequent reaction with appropriate metal salts to form the complexes.

2. **Characterization of the Complexes**

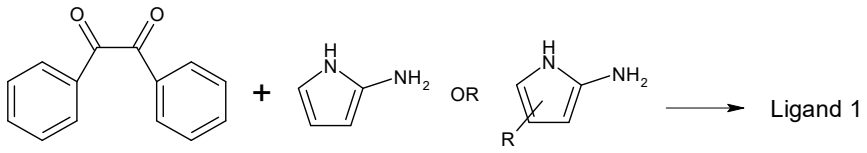
After the synthesis, the next objective is to characterize the resulting complexes. This could involve various techniques such as infrared spectroscopy, ultraviolet-visible spectroscopy, magnetic susceptibility measurements, $H^1$ NMR, mass spectroscopy and thermal analysis.

3. **Biological Study**

The synthesized complexes would then be evaluated for their Biological properties. This could involve testing for antimicrobial, antifungal, anticancer, or other biological activities. The complexes could also be evaluated for their potential use in medical imaging.

## METHODOLOGY

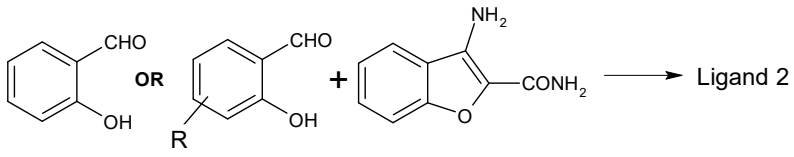
**Scheme 1: Synthesis of ligand 1**




Preparation of metal complex 1

Ligand 1 —Metal→ Schiff Bases Metal Complex

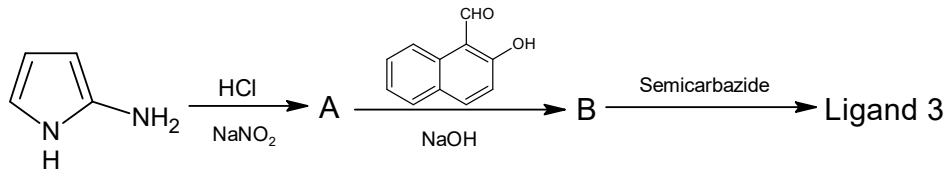
**Scheme 2: Synthesis of ligand 2**




Preparation of metal complex 2

Ligand 2 —Metal→ Schiff Bases Metal Complex

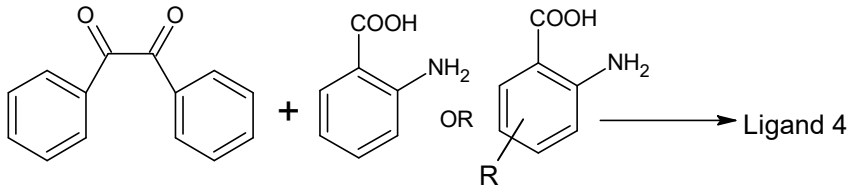
**Scheme 3: Synthesis of ligand 3**




Preparation of metal complex 3

Ligand 3 Metal Schiff Bases Metal Complex

**Scheme 4: Synthesis of ligand 4**




Preparation of metal complex 4

Ligand 4 Metal Schiff Bases Metal Complex

**CHAPTER SCHEME**

The tentative chapter scheme will be as:

**Chapter I : Introduction to co-ordination chemistry**

- Overview of Schiff bases and their significance in coordination chemistry.
- Importance of transition metal complexes in biological applications.
- The introduction of the thesis will summarize these topics and its current status.

**Chapter II: Material and Methodology**

- Synthesis and Characterization of Homo and Heterocyclic Schiff bases.
- Preparation and Characterization of the metal complexes prepared with respective ligands using UV, IR, NMR, Mass, $C^{13}$NMR spectroscopic techniques.

**Chapter III: Biological Activity**

- The results obtained with Homo and Heterocyclic Schiff bases along with their metal complexes were studied for some of theirbiological applications.

**ChapterIV: Results and Discussion**

- The results so obtained were discussed, summarized and concluded in this topic.

**Chapter V: References and publications**

- The references cited in the introduction, materials, methodsand discussion will be summarized in this topic. The publications involve papers published in reputed journal.

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